MASSACHUSETTS NATURAL HERITAGE PROGRAM

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The growth of our population and its demands upon our natural resources are inevitable. Pressure is continually increasing on our remaining natural areas for expanding agricultural, forestry, industrial, and residential needs. It is thus crucial that we develop ecologically sound planning for our continued growth. We must identify those elements of our natural heritage that are most critical for the preservation of our native flora, fauna, ecological associations, and landscape resources.

In 1978, The Nature Conservancy, in cooperation with the Massachusetts Department of Environmental Management, established the Massachusetts Natural Heritage Program. The purpose of this program is to create a continuing process for the identification of the significant natural areas of Massachusetts.

The goal of The Nature Conservancy is, and always has been, the preservation of natural diversity. Within the New England region, Conservancy acquisition efforts have resulted in the preservation of many important biological habitats, including:

— that of populations of the Plymouth Red-bellied Turtle (*Chrysemys rubriventris bangsi*), which has been recommended for listing as a Federally Endangered Species;

— portions of an island on the Maine Coast, including the largest stand of Jack Pine (*Pinus Banksiana*) in the state, stands of *Iris Hookeri, Sedum rosea, Primula laurentiana,* and *Lomatogonium rotatum* (all considered to be rare species in Maine (Eastman, 1978), and examples of rare coastal-plateau raised and blanket bogs.

For the past two decades, The Nature Conservancy has participated in natural area inventories throughout the United States. Through this involvement and experience have evolved the Conservancy's Natural Heritage Programs (Jenkins, 1975, 1976, & 1977). These programs are a new approach to continuous biological collection and management, one which focuses upon the distribution of *individual elements of diversity* (a rare species, plant community, aquatic habitat, etc.) rather than sites or natural areas. By focusing on elements of diversity which are rare or endangered, this

type of inventory concentrates scarce resources on identification and location of examples of those elements that most need protection. Shortcomings of previous natural area inventories such as the New England Natural Areas Project (New England Natural Resources Center, 1972) included (a) a focus upon entire natural area sites, which proved expensive to survey and difficult to compare objectively, and (b) inventories representing only one point in time which quickly became outdated. The Heritage inventory by contrast is ongoing and records alterations in the ever-changing landscape, thus providing a comprehensive data base to meet Massachusetts' growing needs. In conjunction with the element inventory, detailed methods have been developed for determining protection priorities and implementing protection programs.

Since 1974 The Nature Conservancy has established Heritage Programs in twenty-one states (Arizona, Arkansas, California, Colorado, Indiana, Kentucky, Maryland, Massachusetts, Minnesota, Mississippi, New Mexico, North Carolina, Ohio, Oklahoma, Oregon, Rhode Island, South Carolina, Tennessee, Washington, West Virginia, and Wyoming) and the Tennessee Valley Authority, and contracts are being negotiated in a number of other states. Only by combining standard methods and criteria in many state programs can a national perspective on protection needs be achieved.

Natural Heritage Programs are generally conducted in cooperation with state governments, usually under one or two year contracts. The Massachusetts Natural Heritage Program has been established as a unit of the Massachusetts Department of Environmental Management's Office of Planning. Funding for this program has come from the federal Heritage Conservation and Recreation Service, the Commonwealth of Massachusetts, and private donors including the Fund for the Preservation of Wildlife and Natural Areas and the Mabel Louise Riley Trust. The Department of Environmental Management is the major land-managing agency in Massachusetts, administering a quarter of a million acres, and is the only agency with a broad mandate to manage and protect the environment. Species protection is an important part of this effort.

The establishment of a heritage program consists of three phases: program development, pilot inventory, and protection and planning for the preservation of a state's natural heritage. These three phases are briefly outlined below.

PROGRAM DEVELOPMENT

The program development phase includes the creation of a classification system and file structure that will be used to keep track of the data. The classification consists of lists of elements sorted by class. The classes of elements include the rare plants, rare animals, plant communities, aquatic habitats, and significant landscapes and other natural features (see Figure 1). The analysis of the distribution of these elements serves to pinpoint natural areas needing protection. These element lists are drawn up utilizing existing class lists when available. For the classification to be authoritative and effective, we must rely upon the continuing input of the academic community.

In Massachusetts,we are fortunate to have the carefully researched report "Rare and Endangered Vascular Plant Species of Massachusetts" by Coddington and Field (1978). This well-documented list, coupled with the catalytic impetus of Dick Dyer, Regional U.S. Fisheries and Wildlife Service Endangered Species Botanist, and the guiding influence of the New England Botanical Club's Endangered Species Committee (Countryman, Dowhan, & Morse, 1979: Countryman, et al., 1972) will serve as a firm foundation to the rare plant portion of our Heritage Program.

The Massachusetts Division of Fisheries and Wildlife has formulated a list of Vertebrate "Species for Special Consideration in Massachusetts" (1979) which we will be using as a guideline in our program. Our lists of plant communities, aquatic habitats, and significant landscape features are now being developed and we invite all suggestions and additions. It should be emphasized that these lists are not static, being constantly updated as more data becomes available to us.

Data Management System

The data management system constitutes a dynamic atlas of information on the existence, characteristics, numbers, condition, protection status, location, and distribution of occurrences of the state elements. This information is organized in a cross-indexed set of *manual, map,* and *computer* files which permit exceptional flexibility in systems use.

Manual files: The extensive manual files include the Element

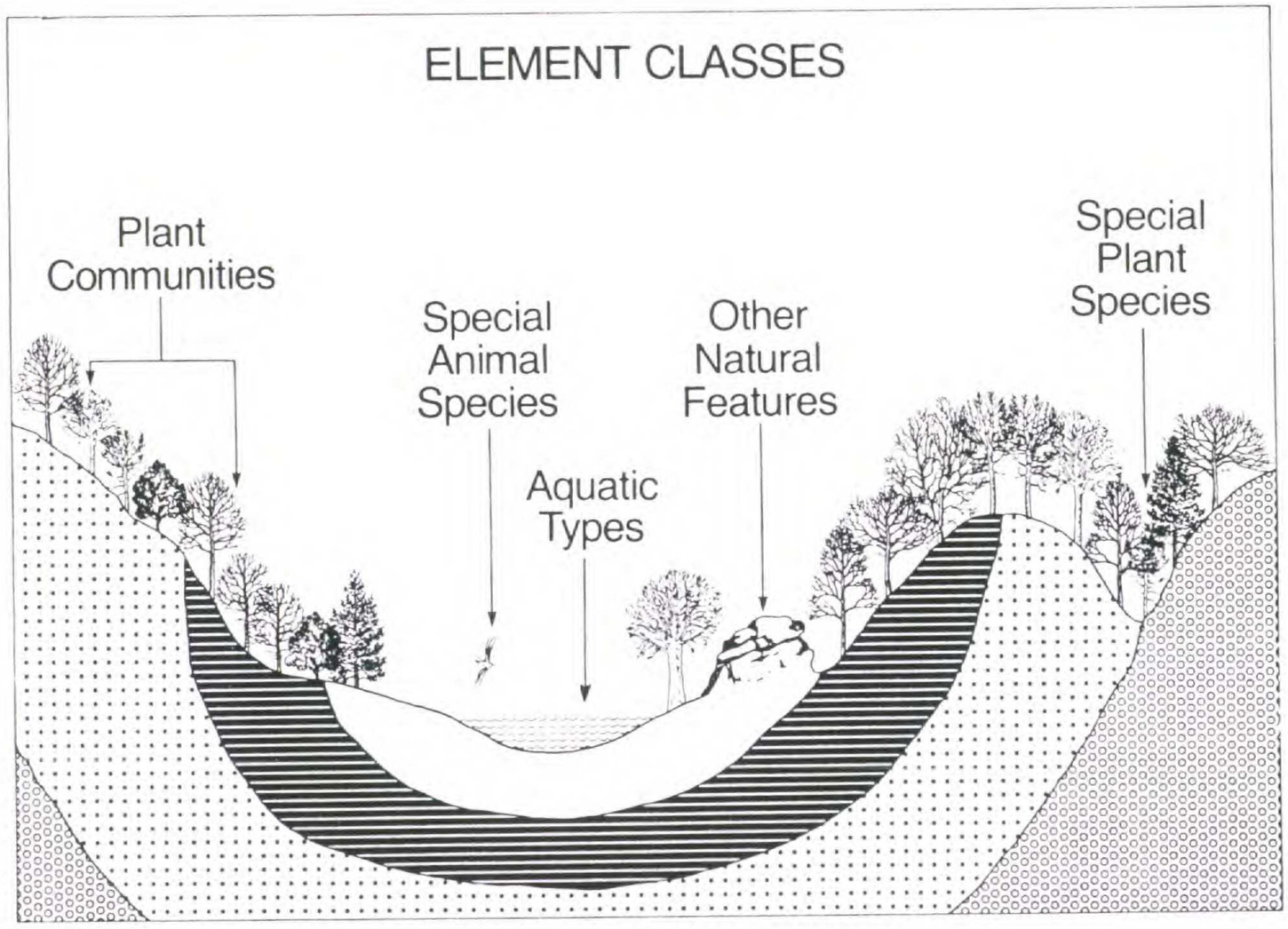

Figure 1. Elements of our natural heritage. (Sanders, 1978)

Files, Element Abstracts, Source Files, Managed Area Files, and Geographic Manual Files. The Element Files contain general monographic information for each rare plant or animal species, plant community type, etc. Any and all information collected by the heritage program for each element is stored or referenced in these files. The Element Abstract contains condensed and summarized information from the Element Files including description, nomenclature, habitat, range, status, proposed management, and sources of information for each element, using the format outlined in the "Guidelines for the Preparation of Status Reports on Rare and Endangered Plant Species" (Henifin, in press; for example, see Morse, in press). The Element Files also include a range map of each element within the 351 cities and towns and 14 counties of Massachusetts.

The Source of Information Files include extensive information concerning the agencies, managed areas, institutions, repositories, societies, knowledgeable individuals, and available literature relating to the elements. The Managed Area Files include maps, aerial photographs, management plans, and species checklists for each managed area in the Commonwealth. This kind of information is essential in determining how well-protected certain occurrences of an element within the state really are, as defined by the management policies of the administering land managing agency.

Map Files: The Map Files are the central component of the element occurrence records in the heritage program. This file consists of a complete set of USGS 1:24,000 scale topographic maps for the state, upon which the location of all element occurrences and managed areas are recorded as accurately as the data will allow. Each map will include a record of historically documented and/or field-verified occurrences of the various elements listed in our state. These maps serve as a essential tool in land-use planning and development conflict-avoidance efforts within the state. For instance, if a project were proposed for a particular site, our maps would indicate if there were a population of rare plants there and how they might be avoided. For each map there is a corresponding file which contains all the supporting information pertaining to the element occurrences and managed areas found on that map. Any other material which can be geographically referenced to that map will be found in this file.

Computer Files: The computerized LCD (Lowest Common Denominator) file is designed to outline the minimum amount of data

necessary for analysis of the locations of occurrences of the elements. These LCD's act as a guide to the more extensive information available in the manual files. The computerized files allow us to sort quickly element occurrence locality information by county, town, physiographic province, owner, watershed, planning region, or various other parameters. The resultant facility in querying, selective retrieving, and editing and purging of the data base greatly aids our efforts to maintain up-to-date information and respond promptly to enquiries.

The computerized component also includes modules for graphic output devices such as X–Y pen plotters and character-mapping programs. These graphic display modules are designed to generate maps depicting the spatial distribution of the occurrences of elements within the state. These distributional range maps can be plotted to any scale, and can be plotted directly on mylars, so that they can easily be used as overlays for base maps.

INVENTORY

Once the lists of elements of special concern within the state have been drawn up, and the manual, map, and computer files established, the major role of the Heritage Program is the coordination of a *continuously* updated inventory of the occurrences and biology of the elements. The landscape is continually undergoing natural and man-made changes; at the same time our understanding and appreciation of ecological processes and species distribution is always expanding. Thus, the revision of the data base must be an ongoing activity; otherwise the data will grow obsolete and lose its utility.

The inventory process combines an extensive search of the scientific literature and repositories, consultation with authorities in their respective fields and, most important of all, intensive field verification efforts and *de novo* searches. Let us reemphasize that the land-use planning and setting of protection priorities resulting from this inventory are only as good as the data base in the information system. If this inventory of the rare elements of the Massachusetts natural environment is to be of any value, there must be constant involvement and input from the scientific community. We do not see ourselves as "the experts" on rare species or characteristic ecological associations in Massachusetts. Many important aspects of the inventory process—developing meaningful classification systems, generating lists of occurrences, and especially conducting the

vital field surveys—can only be accomplished with the enthusiastic support and volunteer efforts of natural scientists, agencies and organizations, and the public at large.

Individuals who would like to participate in the inventory effort are invited to write or call [(617) 749-4565] the Massachusetts Natural Heritage Program for personal "Expertise Survey" forms and for standardized "Observation" forms on which to report populations of rare or endangered species. In the Massachusetts Natural Heritage Program, the continuing inventory process is the product; we are attempting to establish a new program within Massachusetts that will serve as a central clearing house in an extensive inventory of the remaining critical habitats, ecological associations, and landscapes in the state, and so we need the support of the environmental community.

One problem peculiar to rare plant conservation in our region is that *much of the information concerning the distribution and biology of rare species available in the classical botanical literature is unsatisfactory for making critical habitat management decisions.* A majority of our herbarium specimen localities were collected during the New England botanical renaissance about 75 years ago; the New England landscape has changed dramatically since then. Additionally, the New England Botanical Club's Committee on Vascular Plant Distribution has confirmed that there exist areas in our region significantly underexplored botanically (Morse, et al., 1979).

Clearly what is needed is a renewed botanical field effort here in Massachusetts. We need to determine the actual distribution and population status of those species thought to be rare. Last year, Jonathan Coddington and others initiated a field inventory and precise mapping of some older reported rare species localities. Such field verification efforts in Massachusetts should be continued and expanded. By the field season of 1980, our program will have a complete documentation of the historically recorded and presently known populations of Massachusetts' rare species. We will then be in a position to coordinate an extensive field survey effort. The Massachusetts Natural Heritage Program, as part of this coordinated field inventory, needs up-to-date plant occurrence information from knowledgeable botanists across the state.

In addition to distribution field surveys of rare species, there is a need for long term studies of the habitat preferences, population demography, and reproductive biology of the rare and declining

portions of our biota (Anderson, 1980; Graber, 1980). In developing management recommendations for these species it is necessary to know their breeding systems, pollen vectors, seed dispersal mechanisms, habitat requirements, predators, etc. For protection purposes, we need to know which stages in a species' life cycle are most vulnerable. Whitson and Massey (1979) have assembled a comprehensive outline of parameters to be investigated when analyzing the status of a rare plant population. Little information of this kind is presently known for most plant species on our Massachusetts list, and yet such knowledge will be essential for developing management and protection plans. Once again, we are not attempting to initiate single-handed research and conservation efforts; we are attempting to coordinate a functioning public/private natural area identification and protection process.

PROTECTION PLANNING

Periodically the Heritage Program inventory data will be analyzed to determine which natural elements are the most vulnerable in the state. We will tabulate the number of reported occurrences for given elements, and determine which of these occur on adequately protected sites. This analysis will indicate which elements are the rarest in the state and have the fewest protected occurrences and thus are prime candidates for the limited funds that are available for natural area acquisition. This element prioritizing aspect of our information system will feed directly into the acquisition programs of the Department of Environmental Management, The Nature Conservancy, and other land managing agencies and organizations in the state.

A further application of the Heritage Program inventory will be environmental impact review processes, long hindered by a lack of a state, regional, or national perspective. The National Environmental Policy Act (NEPA) requires that environmental impact statements be prepared for all major federal actions. Massachusetts has a similar statute regarding major state actions in the Massachusetts Environmental Policy Act (MEPA). In addition, through the A-95 review process, all states have implemented review procedures for state projects assisted by federal funds, with the state agencies reviewing each others' proposals to eliminate redundancy and conflict (Klein, 1978).

The NEPA and MEPA impact statements and the A-95 reviews are significant for they allow proponents of natural area protection to comment upon poorly sited developments while plans are flexible. The Heritage Program inventory information will allow developers to reduce conflicts before projects are finalized, by avoiding significant sites altogether or by accomodating the natural features involved.

Among potential users for the Massachusetts Natural Heritage Program are the U.S. Fish and Wildlife Service Office of Endangered Species, the Heritage Conservation and Recreation Service National Natural Landmark Program, the U.S. Army Corps of Engineers, the U.S. Department of Transportation, NEPA, the Massachusetts Department of Environmental Management, the Massachusetts Division of Fisheries and Wildlife, the Massachusetts Department of Public Works, MEPA, A-95, regional planning centers, municipal planning boards and conservation commissions, the Trustees of Reservations, the Massachusetts Audubon Society, and The Nature Conservancy.

SUMMARY

The most important product of the Massachusetts Natural Heritage Program is the continuing inventory of Massachusetts' rare natural elements. Our goal is to establish a cooperative effort between the public and private sectors for the identification and protection of those areas which best represent the state's natural heritage.

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